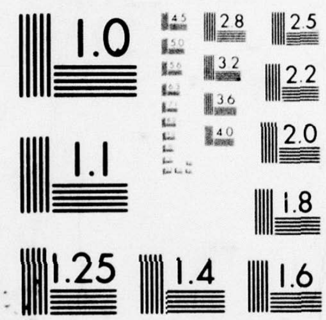
AD-A036 145 COLD REGIONS RESEARCH AND ENGINEERING LAB HANOVER N H F/G 8/13
RESEARCH ON PERMEABILITY OF CERTAIN KINDS OF WEAK WATER-SATURAT--ETC(U)
FEB 77 B KIROV

UNCLASSIFIED CRREL-TL-587 NL

1 OF 1
AD
A036145

END
DATE
FILMED
3-77


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6

TL 587

Draft Translation 587
February 1977

12

RESEARCH ON PERMEABILITY OF CERTAIN KINDS OF WEAK WATER-SATURATED SOILS

B. Kirov

CORPS OF ENGINEERS, U.S. ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
HANOVER, NEW HAMPSHIRE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Draft Translation 587

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): RESEARCH ON PERMEABILITY OF CERTAIN KINDS OF WEAK WATER-SATURATED SOILS

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): B. Kirov

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

12. REPORT DATE: February 1977

13. NUMBER OF PAGES: 6

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

SOILS--PERMEABILITY

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Permeability is an exceptionally important soil characteristic for the planning of engineering structures. This report discusses how to calculate the consolidation of the earth mass.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DRAFT TRANSLATION 587

6

ENGLISH TITLE: RESEARCH ON PERMEABILITY OF CERTAIN KINDS OF WEAK WATER-SATURATED SOILS

FOREIGN TITLE: (IZSLEDVANIIA V'RKHU VODOPROLUSKLIVOSTA NA NIAKOLKO VIDA CLAVI VODONASITENI POCHVI),

10 Borislav Kirov

11 Feb 77

AUTHOR: B. Kirov

12 9p.

21 Trans. of

SOURCE: Gidrotekhnika, [redacted] V19 [redacted] N9 p 25-27 1974.

(USSR)

Translated by Office of the Assistant Chief of Staff for Intelligence for U.S. Army Cold Regions Research and Engineering Laboratory, 1977, 6p.

14 CRREL-TL-587

NOTICE

The contents of this publication have been translated as presented in the original text. No attempt has been made to verify the accuracy of any statement contained herein. This translation is published with a minimum of copy editing and graphics preparation in order to expedite the dissemination of information. Requests for additional copies of this document should be addressed to the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

037100

RESEARCH ON PERMEABILITY OF CERTAIN KINDS OF WEAK WATER-SATURATED SOILS

by Engineer Borislav Kirov

Gidrotekhnika (Hydraulic Engineering),
Vol. 19, No. 9, 1974, pp. 25-27

Permeability is an exceptionally important soil characteristic for the planning of engineering structures. It must be determined precisely in order to calculate the consolidation of the earth mass.

The Weak-Soil "Problem" Research Laboratory headed by Docent Candidate of Technical Sciences M. Yu. Abelev in the Soil Mechanics and Foundations Department of the V. V. Kuybyshev Moscow Civil Engineering Institute performed a series of filtration experiments with undestroyed samples of the following varieties of soil: sandy mud, clayey mud and buried peat. Previously vacuum-evaporated sea water was used for filtration. The purpose of the research was to determine the variation of permeability as a function of the degree of soil compaction and pressure gradient. The experiments were performed with the help of an F-1M filtration compressor (Figure 1). It is a compressor with a hermetically sealed holder permitting the passage of water through a soil specimen according to "top-to-bottom" and "bottom-to-top" flow patterns under varying pressure. The installed soil specimen is 0.04 meter high and has a cross-section $F=50 \cdot 10^{-4}$ square meter.

Three undestroyed samples of each variety were tested. The characteristics of the various soils in the natural state are given in Table 1.

The first task we set ourselves in conducting the experiments was to determine whether the so-called phenomenon of "initial pressure gradient" is observed during filtration through these varieties of weak water-saturated soils, i.e., whether there is some certain pressure gradient value, although there are smaller values, from which no filtration is observed, or if it is observed, it will be many times weaker [1].

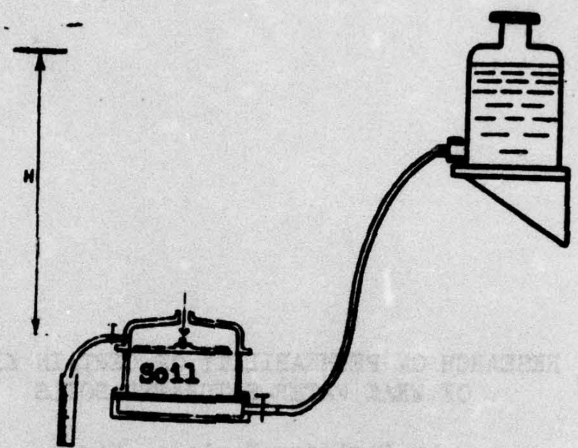


Figure 1

Table 1

1 Вид почва	5 Обемна плътност ρ [g/cm³]	6 Специфична плътност ρ_s [g/cm³]	7 Водно съдържание ω [%]	8 Коефициент на порите e
2 Песъчлива тиня	1.42	2.65	118	3.06
3 Глинеста тиня	1.40	2.63	83	2.44
4 Погребан торф	1.01	1.95	430	9.23

Key:

1. **Soil type**
2. **Sandy mud**
3. **Clayey mud**
4. **Buried peat**
5. **Bulk density**
6. **Specific density**
7. **Water content**
8. **Porosity factor**

Darcy's equation then assumes the following form:

$$V_f = K_f(i - i_o),$$

where V_f is filtration rate,
i is pressure gradient, and
i_o is initial pressure gradient.

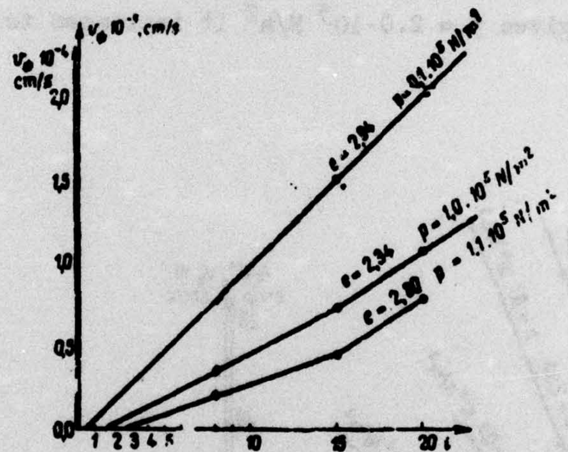


Figure 2a. Sandy mud

The instrument used is so constructed as to permit filtration to take place at different pressures. Pressure is created by moving the reservoir of water to a different height relative to the tested specimen. Water was passed through a specimen according to the "bottom-to-top" flow pattern, after which it was collected in a graduated cylinder. Lest the water evaporate from the graduated cylinder, several drops of oil were dropped into it. All experiments were performed at pressures of 0.32 meter, 0.60 meter and 0.80 meter. Filtration rate and coefficient were determined several times for each one of the given pressures [2]. Water temperature was measured constantly during the experiments and all results have been referred to a temperature of +10° C. Experiments were conducted at various vertical loads with a wait at each loading step for subsidence to stabilize at $0.01 \cdot 10^{-3}$ meter in 12 hours. Graphs were constructed for every value of vertical load according to the obtained data for variation of filtration rate as a function of pressure gradient. Extensions of

the straight lines joining individual experimental points to their intersection with the axis of pressure gradients mark off on it the initial gradient value at which filtration begins (Figure 2). The initial pressure gradient obtained according to the thus-described methodology was checked by filtering water through the same soil sample at a gradient less than the initial gradient. From the graphs in Figure 2 it can be seen that for sandy mud the initial gradient increases as the vertical load increases. For clayey mud the initial gradient remains practically unchanged with an increase of the vertical load in the tested range due to low compressibility (the porosity factor varied from 2.44 to 2.25). For buried peat the same pattern as for sandy mud was observed, i.e., the initial pressure gradient increases with an increase of the vertical load. Given $p = 1.0 \cdot 10^5$ N/m^2 it equals 1.2, while given $p = 2.0 \cdot 10^5$ N/m^2 it increases to 3.2.

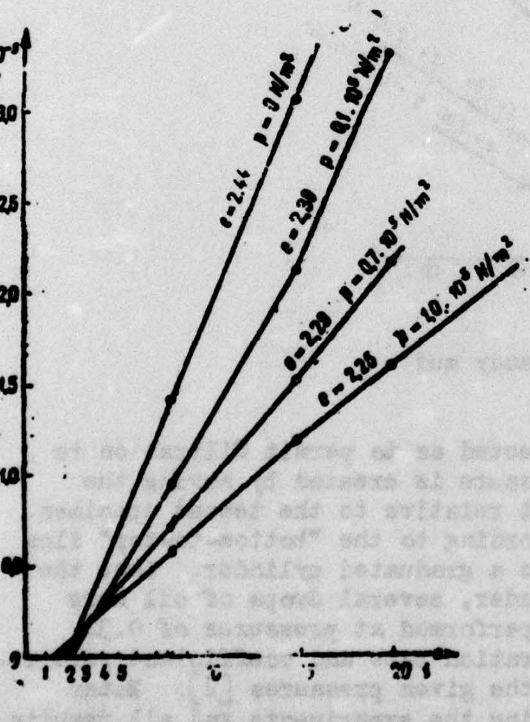


Figure 2b. Clayey mud

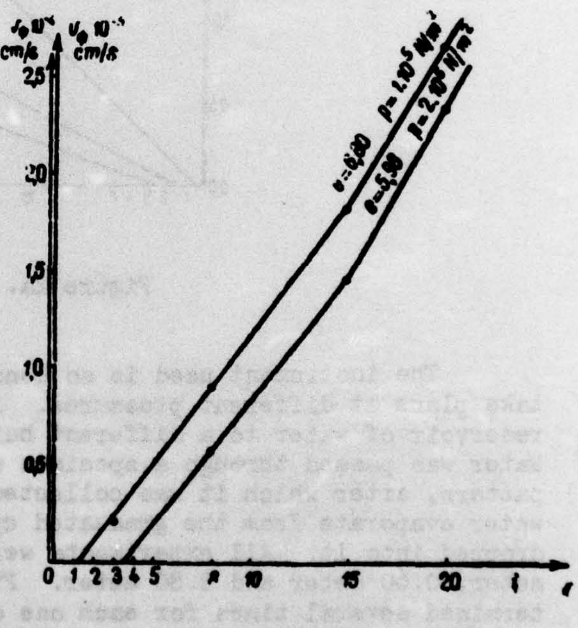


Figure 2c. Buried peat

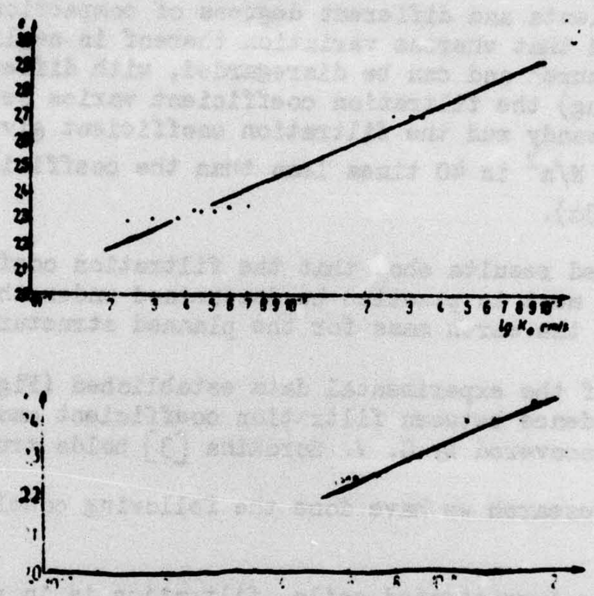


Figure 3a, b. Sandy mud; clayey mud.

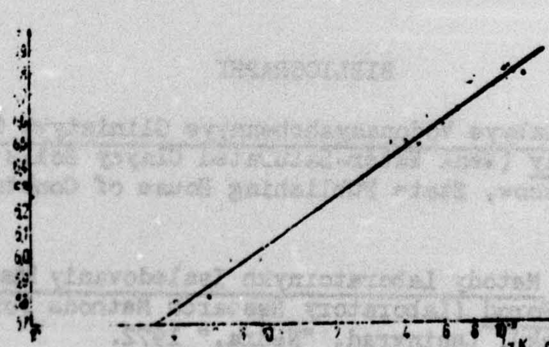


Figure 3c. Buried peat

The second task we set ourselves in the experiments here conducted was to investigate the variation of the filtration coefficient at different pressure gradients and different degrees of compaction (vertical loads). The results showed that whereas variation thereof is negligible for the investigated pressures and can be disregarded, with different degrees of compaction (loading) the filtration coefficient varies several fold. Thus, for example, for sandy mud the filtration coefficient given vertical load $p = 1.1 \cdot 10^5$ N/m^2 is 40 times less than the coefficient given $p = 0.1 \cdot 10^5$ N/m^2 (Figure 3a).

The obtained results show that the filtration coefficient for these varieties of soil must in practice be determined under the same vertical loads under which the earth mass for the planned structure will find itself.

Analysis of the experimental data established (Figure 3) that the logarithmic dependence between filtration coefficient and porosity factor in muddy soils discovered by G. V. Sorokina [3] holds true.

From the research we have done the following conclusions can be drawn:

1. For the investigated soils, filtration is in practice observed only at gradients greater than the initial gradient, which increases as the porosity factor declines, i.e., as the vertical load increases.

2. For the investigated soil varieties there is a logarithmic dependence between the filtration coefficient and porosity factor.

3. Filtration research for weak water-saturated soils must be conducted under the vertical loads that will be observed at the planned structure.

BIBLIOGRAPHY

1. M. Yu. Abelev, Slabyye Vodonasyshchennyye Glinistyye Grunty kak Osnovaniya Sooruzheniy (Weak Water-Saturated Clayey Soils as Structural Foundations), Moscow, State Publishing House of Construction Literature, 1973.

2. V. D. Lomtadze, Metody Laboratornykh Issledovaniy Fiziko-Mekhanicheskikh Svoystv Gornykh Porod (Laboratory Research Methods for Physicomechanical Properties of Rock), Leningrad, "Nedra," 1972.

3. G. V. Sorokina, "Physicomechanical Properties of Sea Muds," Stroitel'noye Gruntovedeniye (Construction Soil Science), Collection of Works No. 42 of NIIOSP [Scientific Research Institute of Foundations and Underground Structures], State Publishing House of Literature on Construction, Architecture and Building Materials, 1960.

- END -